On the questionable record of the Balkan Grayling, *Hipparchia senthes* (Fruhstorfer, 1908), in Croatia (Lepidoptera: Nymphalidae, Satyrinae)

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Abstract: The Balkan Grayling, *Hipparchia senthes* (Fruhstorfer, 1908), has recently been reported for the Adriatic island of Cres, Croatia. As this is the most northwestern record of this species in general, with several questionable circumstances regarding this record, we intended to confirm the occurrence of this species in Croatia. We checked the genital structure of about a hundred specimens belonging to the *H. semele* group from different regions of Croatia, including more than 60 specimens collected from Cres island. Our analysis shows that *H. senthes* cannot be confirmed to be a member of the Croatian butterfly fauna, as all the checked material belonged to *H. semele*. The nearest known population originates from Macedonia, so the chances that *H. senthes* is present in some other part of Croatia are very small. The record from Cres Island probably represents a mislabeled specimen. With all known facts we suggest the removal of *H. senthes* from Croatia's butterfly list.

Keywords: butterflies, Cres, genitalia, doubtful occurrence, genitalia.

Über den zweifelhaften Nachweis von *Hipparchia senthes* (Fruhstorfer, 1908) für Kroatien (Lepidoptera: Nymphalidae, Satyrinae)

Zusammenfassung: *Hipparchia senthes* (Fruhstorfer, 1908) wurde kürzlich von der Adriainsel Cres in Kroatien gemeldet. Da es sich dabei um den nordwestlichsten Nachweis der Art insgesamt handelte und einige fragwürdige Fundumstände berichtet wurden, war unsere Intention, den Nachweis für Kroatien zu verifizieren. Wir untersuchten etwa hundert Genitalarmaturen von Faltern der Artengruppe von *Hipparchia semele* aus unterschiedlichen Regionen Kroatiens, davon über 60 Exemplaren von der Insel Cres. Unsere Analyse zeigt, daß die Zugehörigkeit von *H. senthes* zur Tagfalterfauna Kroatiens nicht bestätigt werden kann, da alle untersuchten Falter zu *H. semele* gehörten. Die nächstgelegene Population von *H. senthes* findet sich in Makedonien, so daß die Chancen des Nachweises in Kroatien minimal sind. Der Nachweis von Cres basiert wohl auf einem fehletikettierten Exemplar. Wir empfehlen, *H. senthes* deswegen von der kroatischen Faunenliste wieder zu streichen.

Introduction

The genus *Hipparchia* Fabricius, 1807 comprises about 34 species, 28 of which are present in Europe (van Swaay et al. 2010). The members of this genus are large, usually cryptically colored species, with only slight external morphological differences among them. Due to the high interspecific variability and the lack of clear external morphological differences, the analysis of the genitalia is usually required for the correct identification of many species (Tolman & Lewington 2008). In regard to that, several new species were described in the last 50 years from the territory of Europe (Kudrna 1977, 1984). Traditionally, several problematic groups of European species are recognized within this genus, of which two main groups are the *fagi*- and *semele*-groups (Coutsis 1983). In Croatia, both groups of species probably occur, but the real number of species is still somewhat enigmatic. In the territory of former Yugoslavia the *fagi*-group of species was studied by Lorković (1976) who showed that only two species inhabit the area, *Hipparchia fagi* (Scopoli, 1763) in the northern part and *Hipparchia syriaca* (Staudinger, 1871) in the coastal region of the country. Lorković (1976) also excluded *Hipparchia alcyone* ([Denis & Schiffermüller], 1775) from the species list, and stated that all historical findings refer to the mentioned species rather than *H. alcyone*.

The situation with the *semele*-group of species in the Balkans is generally still not clear. The recent morphological analysis of the *semele*-group in the Balkan area (Wakeham-Dawson et al. 2004) showed that 3 closely related species occur in the area: *Hipparchia muelleri* Kudrna, 1975, *Hiparchia delattini* Kudrna, 1975 and *Hipparchia semele* (Linnaeus, 1758). And while several authors showed that all 3 species occur in the Balkans, their geographic boundaries are far from clear, especially in the northern Balkans, in Bosnia and Herzegovina and in Croatia.

In addition to these species, a southern Balkan species belonging to the *semele*-group, *Hipparchia senthes* (Fruhstorfer, 1908), was reported from one of the Adriatic island, Cres Island (Micevski & Micevski 2005). This species was accepted as a part of the Croatian butterfly fauna (Šašić & Mihoci 2011), but its questionability had been noted.

This makes the situation with the historical records of *H. semele* specimens even more complicated, especially regarding the fact that in the most published papers from the territory of Croatia, the records of *H. semele* specimens were cited as is, without checking the genital structures (e.g. Mihoci et al. 2007, Koren & Ladavac 2010).

H. semele is present in northern, central and western Europe, on the Balkan Peninsula and to the South along the western side of Greece (Wakeham-Dawson et al. 2004). One generation flies from June to September on habitats like dry grassy, rocky or sandy places, in deciduous, mixed or coniferous forests, on dry sunny slopes, on costal cliffs. Larval hostplants are grasses (Poaceae) (Tolman & Lewington 1997, 2008).

H. senthes was originally described as a subspecies of *Hipparchia aristeus* (Bonelli, 1826), from Taygetos

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Mts. in southern Greece (Tolman & Lewington 2008). Nowadays, it has received species status (van Swaay et al. 2010). This is a southeastern European species, distributed from Albania and Macedonia in the North, across southern Bulgaria, Greece and Turkey, including southern Italy and Sicily (Olivier & Coutsis 1997, Tolman & Lewington 2008). One generation flies from late May to mid-August, depending on the locality, in or near deciduous woodland clearings and on dry bushy and/or rocky places. Larval hostplants are unknown, apparently grasses (Poaceae) (Olivier & Coutsis 1997, Tolman & Lewington 1997). This species closely resembles *H. semele,* and the only unquestionable way of distinguishing them is the preparation of ♂ genitalia.

In this study we wanted to clear the following:

- Whether *H. senthes* really occurs on Cres Island or other localities in Croatia, and if not:
- exclude this species from the list of butterflies of Croatia until new records can be confirmed.

Materials and methods

Field work

Field work was done from 2000 to 2012 on a wide area of western and southern Croatia, mainly on the shoreline and the Adriatic islands (see Fig. 1, map). We concluded that the islands and the coastline would represent the optimal habitat for this species in Croatia, with the record from Cres in mind (Micevski & Micevski 2005). Specimens belonging to the *semele*-group were collected with an insect net and stored in the private butterfly collection of the first author. For each specimen, locality, collection date as well as the coordinates were noted. In the lab, abdomens of each specimen were cut, and genital slides were prepared following standard procedure of overnight maceration in a 10% KOH solution, then washed in water and dehydrated in 95% ethanol (Clarke 1941, Coutsis 1983). Mounting on a microscopic slides was done using Euparal. The determination of the specimen's genitalia followed Coutsis (1983).

Morphological characteristics of the genitalia of *Hipparchia semele* and *H. senthes*

Morphological characteristics of the ♂ and ♀ genitalia in the various taxa of the *semele*-group represent the modus of their taxonomic classification. Some allopatric taxa show little morphological difference in the genitalia. Therefore the determination of species is sometimes subjective and questionable (Coutsis 1983).

The main difference in ♂ genitalia between *H. semele* and *H. senthes* is in the shape of the uncus, which is shorter and broader in *H. senthes,* while longer and much more slender in *H. semele* (Coutsis 1983). The main difference between ♀ genitalia of *H. semele* and *H. senthes* is the shape of the upper part of the corpus bursae, which is concave in *H. semele,* while more convex in *H. senthes*. For the details see Coutsis (1983) and Olivier & Coutsis (1997).

Fig. 1: Map of Croatia with locations where the samples of *Hipparchia semele* were collected (black triangles), and the doubtful report of *H. senthes* (white asterisk).

Results and discussion

For the correct species identification in the group of *H. semele* we checked the genitalia of a total of 104 individuals, 84 ♂♂ and 20 ♀♀ (Tab. 1). Our samples originated from almost all of the shoreline, from the Istrian peninsula in the north, islands Cres, Rab, toward southern Dalmatia and Dalmatinska Zagora. All the collected individuals undeniably belonged to *H. semele*.

What is important to note is that the record of *H. senthes* from Cres Island was published along with several other species as a contribution to the fauna of Cres Island (Micevski & Micevski 2005). In general, the paper about the butterflies of Cres Island contains at least one more obvious mistake. The authors list *Lasiommata petropolitana* (Fabricius, 1787), a typical mountain species, as a member of the Cres Island fauna. This was later discarded by Mihoci & Šašić (2009) as an erroneous record.

Regarding the record of *H. senthes*, as this was the most northern record of this species in general, as well as the first record for Croatia, one would presume that the importance of this record would be more expressed in such a paper, along with the drawing of the genitalia. However, the record of this species on Cres Island was mentioned only as a part of the butterfly list recorded on the island, without any note on a genitalia dissection (Micevski & Micevski 2005). The authors only state that *H. senthes* was recorded two times on Cres Island, first on 11. ix. 2005, above the village Beli, on a "green path above the main path, near a dry stone wall", and for the second time also above Beli, on 13. ix. 2005 (Micevski & Micevski 2005). Above the village lays the Tramuntana forest, one of the larger and most pristine forests on the Adriatic islands. The mosaic of forests, pastures, as well as forest clearings renders this area very favorable for *Hipparchia* species.

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Table 1: List of localities in Croatia where *Hipparchia* specimens of the *semele*-group were collected and their genitalia checked for the occurrence of *H. senthes*.

No.	Location	Coordinates		Sex		Date
		°E	°N	♂	♀	
1.	Cres Island, Tramuntana	45.107666	14.338188	7	1	14. VI. 2011
–	Cres Island, Tramuntana	45.107666	14.338188	22	3	21. VI. 2011
–	Cres Island, Tramuntana	45.107666	14.338188	2	–	15. VIII. 2011
2.	Cres Island, 500 m N of Batajna	44.917167	14.413376	2	–	19. VI. 2012
3.	Cres Island, Beli	45.111937	14.354324	6	1	30. VI. 2012
4.	Cres Island, Orlec	44.891634	14.426765	6	–	11. VII. 2012
5.	Cres Island, Porozina	45.131619	14.285917	2	1	11. VII. 2012
6.	Cres Island, Punta Križa	44.639590	14.490967	1	1	11. VII. 2012
7.	Cres Island, Predošćica	45.042054	14.368315	8	–	30. VI. 2012
8.	Pazin, Istra	45.236701	13.931780	2	1	5. VII. 2008
9.	Brestova, Istra	45.144939	14.223261	3	–	10. VII. 2012
10.	Mt. Dinara, Sinjal	44.063717	16.380200	3	2	6. VIII. 2012
11.	Mt. Dinara, Duler	44.083600	16.358917	–	1	5. VIII. 2012
12.	Mt. Dinara	44.104083	16.324383	1	2	4. VIII. 2012
13.	Mt. Dinara	44.097517	16.297700	–	3	4. VIII. 2012
14.	Mt. Kamešnica, Ćalete	43.662377	16.916413	4	–	8. VIII. 2012
15.	Mt. Platak	45.411406	14.562550	1	–	14. VI. 2002
16.	Mt. Kučina Kosa, Poštak peak	44.261045	16.103125	1	1	9. VIII. 2012
17.	Mt. Učka, Vojak	45.274886	14.201546	–	1	24. VI. 2001
18.	Mt. Učka, Mala Učka	45.276638	14.192963	3	–	15. VII. 2000
19.	Mt. Velebit, Zavižan	44.807965	14.970503	1	1	10. VII. 2002
20.	Murter island, Murter	43.817189	15.587540	2	1	19. VIII. 2012
21.	Novi Vinodolski, Kolevrat	45.116233	14.913958	1	–	10. VIII. 2012
22.	Mt. Velebit, Paklenica, Ivančev Dom	44.345817	15.483108	3	–	22. VIII. 2010
23.	Rab Island, Suha Punta	44.763799	14.725628	1	–	10. IX. 2011
24.	Rab Island, Barbat	44.738320	14.804935	3	1	10. IX. 2011
25.	Senj, Brižak	45.023489	14.946794	1	–	10. VIII. 2012
26.	Vrelo Zrmanje, spring	44.196790	16.056175	1	–	20. VII. 2010
26.	Šibenik, Bilice	43.787702	15.874557	4	–	17. IX. 2012
Total:				**84**	**20**	

It was brought to our attention that the genitalia slide from one specimen originating from Cres Island, from the Micevski collection, was indeed prepared and checked by Rudi Verovnik, who confirmed that this is indeed *H. senthes*. This was later additionally confirmed by O. Kudrna (Verovnik, pers. comm.). However, there is a question about the origin of this specimen. Both authors of the mentioned paper live and work in Macedonia, where *H. senthes* indeed is present. Regarding that fact, there is a high probability that an error with the specimen's labels occurred, and the Macedonian material was accidently mixed with material from Cres Island. We need to stress that the specimens from Cres Island were obviously determined only by external morphology, which is far from being reliable, and the genitalia were checked only after the publication of the paper. This can be seen from the paper itself, where the authors state that *H. senthes* was one of the commonest butterflies above the Beli village on Cres. We visited this area many times, and collected more than 30 specimens of the *semele*-group. Since Micevski & Micevski (2005) do not give an exact coordinate of the collecting site in their paper, we can only assume that we covered exactly the same place, or at least locations near the supposed collecting site of *H. senthes*. With that in mind, there is a high probability of the material being mislabelled. A similar situation was regarding the interesting specimen of *Leptidea duponcheli* (Staudinger, 1871) from another Croatian island (Kučinić et al. 2009). In that case a specimen also existed, but the authors concluded that a mix-up with the labels occurred.

Regarding the flight time, *H. senthes* flies in a single generation, from late May to mid August, while *H. semele* flies from the second half of July until the first half of September (Tolman & Lewington 2008). In regard to that, we wanted to collect *Hipparchia* specimens as early in season as possible, so there would be higher chances for them to belong to *H. senthes*. The earliest record from Cres Island was on 14. VII., which could be just the time in

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which *H. semele* has not yet started to fly. However, all the specimens collected on that day belonged to *H. semele*.

All in all, our data suggest that *H. senthes* is not present on the Cres Island, as well as at other checked localities in Croatia; however, it is almost impossible to confirm the absence of a species, so a possibility that *H. senthes* occurs in some isolated population in Croatia will always remain an option. While there are some suitable habitats for this species in Croatia, as well as on Cres Island (including dry, rocky and bushy places or bushy woodland clearings), as well as larvae host plants, the distance between the closest known populations and the possible population from Cres Island is measured in hundreds of kilometers. The nearest records of *H. senthes* are from the former Yugoslav Republic of Macedonia (e.g., in the Vardar valley: Titov Veles, Delcevo, see Jakšić 1988, Schaider & Jakšić 1989).

One additional question regarding the group of *H. semele* in Croatia still remains open: are any or both endemic Balkan species, *H. delattini* and *H. muelleri*, mentioned by Wakeham-Dawson et al. (2004), really present in Croatia? The records of these species for Croatia were not explicitly mentioned in the papers, but the morphometric analysis which the authors did on the genitalia of *Hipparchia* specimens suggested that some specimens from Croatia belong to these two species. This will need to be checked properly in the future, with genetic or morphometric data done on a larger data set. The situation is also far from clear in the area of Bosnia and Herzegovina and Serbia. For the territory of Bosnia and Herzegovina Lelo (2007) mentions only *H. semele,* while for the territory of Serbia, only *Hipparchia volgensis* (Mazochin-Porshniakov, 1952) was mentioned (Popović & Đurić 2011). Future studies of this interesting genus will probably reveal new data about the distribution and species relationships between these species.

Conclusions

After the overview of our data, as well as the all known facts regarding the record of *H. senthes* from the Cres Island, we can conclude that this species is most likely not a member of the Croatian butterfly fauna. A small possibility that *H. senthes* occurs in Croatia still exists, but almost certainly not on Cres Island or along the northern parts of the seashore. There is a small probability that this species is present in the southernmost part of the country, but regarding the fact that the closest records of this species originate several hundred kilometers to the southeast, in Macedonia and Albania, chances for that are very small. With all that in mind, we suggest the exclusion of *H. senthes* from the butterflies list of Croatia.

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